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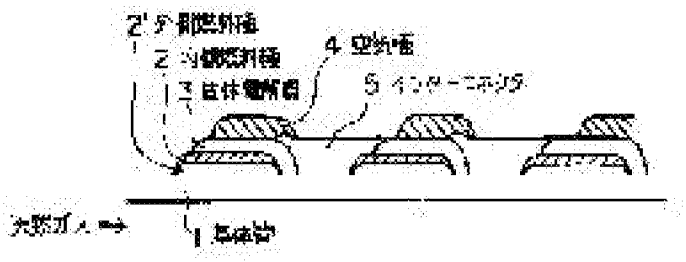
(54) FUEL ELECTRODE OF SOLID ELECTROLYTIC FUEL CELL FOR INTERNAL REFORMING

(57)Abstract:

PROBLEM TO BE SOLVED: To enhance power generating performance by using NiO/YSZ of low reaction resistance on the interface of a solid electrolyte and NiO/MgAl2O4 on carbon deposition by natural gas.

SOLUTION: A fuel electrode of two layer structure of an outside fuel electrode 2 made of NiO/MgAl24O4 and an inside fuel electrode 2 made of NiO/YSZ is formed as a film on a substrate tube 1, then a solid electrolyte 3, an interconnector 5, and an air electrode 4 are formed in the form of a film to manufacture a cell. Natural gas supplied into the substrate tube 1 is passed through the wall of the substrate tube 1, reaches the fuel electrode arranged on the outer circumference of the substrate tube 1, and natural gas (CxHy)+H2O is brought into contact with the outside fuel electrode 2, reformed, and converted into CO/H2. Since NiO/MgAl2O4 of the material of the outside fuel electrode 2 is a material hardly depositing carbon, deterioration in power generating performance caused by carbon deposition is not produced different from the conventional NiO/YSZ



material. High operating voltage is maintained over a long period.

CLAIM + DETAILED DESCRIPTION

[Claim(s)]
[Claim 1] In the inside which touches a solid electrolyte in the solid oxide fuel cell cell which reforms natural gas inside a cell, the outside is NiO/MgAl 2O4 at NiO/YSZ. Fuel electrode of the solid oxide fuel cell cell for internal property modification characterized by consisting of two-layer structure.

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the fuel electrode which the solid oxide fuel cell cell (it abbreviates to SOFC hereafter) which reforms natural gas inside a cell made highly efficient.
[0002]
[Description of the Prior Art] Development of the cell for internal property modification which the conventional SOFC was developing the cell which assumed hydrogen to the fuel, and used natural gas does not have ******** crack ****. Therefore, power generation which used natural gas for the fuel as shown in drawing 5 in the cell supposing hydrogen was performed. In addition, in drawing 5 , a fuel electrode and 3 show a solid electrolyte, 4 shows an air pole, and, as for a base pipe and 2, 1 shows INTAKONEKUTA 5.
[0003]
[Problem to be solved by the invention] The conventional SOFC for internal property modification corresponded in the cell which assumed as a fuel that hydrogen mentioned above. However, in SOFC for internal property modification using natural gas, in order to throw the hydrocarbon of natural gas into the inside of a cell, as shown in drawing 6 , the carbon deposit took place to the fuel electrode, and deterioration of performance was accepted. This is considered because the performance of a carbon-proof deposit is inferior to the material of NiO/YSZ usually used for a fuel electrode.
[0004]
[Means for solving problem] As for this invention, in the solid oxide fuel cell cell which reforms natural gas inside a cell, the inside which touches a solid electrolyte is NiO/YSZ, and the outside is NiO/MgAl 2O4. It is the fuel electrode of the solid oxide fuel cell cell for internal property modification characterized by consisting of two-layer structure.
[0005] It is necessary to use a material excellent in the carbon-proof deposit for the fuel electrode

material of SOFC for internal property modification. It is NiO/MgAl 2O4 as this candidate material. Although it is, and this thing is excellent in the carbon-proof deposit, as shown in drawing 4 compared with conventional NiO/YSZ, reaction resistance may become high and the performance of a cell may become low compared with the former. Then, in order to solve these problems, this invention is NiO/YSZ to the outside in the fuel electrode of the direction near the solid electrolyte of SOFC for internal property modification of this invention, as shown in drawing 1 NiO/MgAl 2O4 It is used. That is, in a solid electrolyte interface, low NiO/YSZ of reaction resistance is related with the carbon deposit by natural gas, and it is NiO/MgAl 2O4. It enables it to raise the power generation performance of SOFC for internal property modification by using it.

[0006]

[Mode for carrying out the invention] Generally as for NiO/YSZ which touches a solid electrolyte (although YSZ is generally used CSZ and CeO2), NiO:40 - 80vol% and YSZ:60-20% of a mixture is used. The electrode process in which NiO/YSZ participates advances by the 3 phase interface of NiO/YSZ (electrolyte)/gaseous phase. For this reason, although it is more desirable to add many YSZ(s) as much as possible to the increase in a 3 phase interface, if a NiO ratio falls, the number of NiO/YSZ points of contact will fall, and the contact resistance in an interface will increase. Therefore, you may be 40 - 80vol% as a proper range of the NiO ratio which stops the increase of the amount of 3 phase interfaces, and contact resistance.

[0007] Outside NiO/MgAl 2O4 Generally it is NiO:70 - 40vol% and MgAl2 O4. : 30 - 60vol% of a mixture is used. NiO/MgAl 2O4 While it is possible to suppress a carbon deposit, it contributes to electric conduction. For this reason, the electric conductivity of a fuel electrode needs to secure 1000 or more S/cm, and although it is desirable for that to make a NiO ratio high, if a NiO ratio is high, it will damage according to a thermal expansion difference with an electrolyte (YSZ). For this reason, you may be 70 - 40vol% as a proper range of a NiO ratio.

[0008] NiO/YSZ and NiO/MgAl 2O4 thickness -- respectively -- former: -- the range of 20-50 micrometers and latter:100-200micrometer is common. In order that a NiO/YSZ film may participate mainly in an electrode process, thickness may be thin, and in order to reduce the influence by the coefficient-of-thermal-expansion difference of a NiO/YSZ system, you may be 20-50 micrometers as thickness. NiO/MgAl 2O4 Since a film contributes mainly to electric conduction, the thicker one of thickness is good, and compared with a NiO/YSZ system, the influence of a coefficient-of-thermal-expansion difference is small. For this reason, you may be 100-2000 micrometers as thickness.

[0009]

[Working example] The concrete work example of the fuel electrode of SOFC for internal property modification of this invention is given hereafter, and the effect of this invention is clarified. The base pipe with which 1 consists of 20vol%NiO/CSZ in drawing 2 , thickness which 2 becomes from a grain size:0.5-1micrometer NiO:50vol% and grain size:2-5micrometer YSZ:50vol% : The diameter of an inside fuel which consists of 20-30 micrometers, 2' -- grain size: -- NiO:60vol% and grain size: -- 5-10-micrometer MgAl2 O4 : thickness: which consists of 40vol -- about 150-micrometer outside fuel electrode -- [of 0.5-1 micrometer] the solid electrolyte with which 3 consists of YSZ, and 4 -- LaMeMnO -- three (however, Me:Sr, Ca) -- the air pole which consists of a perovskite type oxide, and 5 -- NiAl/aluminum 2O3 INTAKONEKUTA which consists of cermet is shown.

[0010] On the base pipe 1, it is NiO/MgAl 2O4. The fuel electrode of the two-layer structure of the inside fuel electrode 2 which consists of becoming outside fuel electrode 2' and NiO/YSZ was formed,

and the cell which formed the solid electrolyte 3, INTAKONEKUTA 5, and an air pole 4 was manufactured as usual after that. Although the fuel electrode which the natural gas supplied in the base pipe 1 passed base pipe 1 wall, and has been arranged at the peripheral face of a base pipe is reached the above-mentioned passage -- a fuel electrode -- NiO/MgAl 2O4 from -- since it consists of inside fuel electrodes 2 which consist of becoming outside fuel electrode 2' and NiO/YSZ, natural gas (CxHy) +H2 O contacts outside fuel electrode 2' first, and property modification is carried out -- CO and H2 It changes. NiO/MgAl 2O4 which is the quality of the material of outside fuel electrode 2' in that case Since it is the material into which carbon cannot deposit easily, deterioration of the power generation performance by carbon deposit does not arise like conventional NiO/YSZ. Therefore, as shown in drawing 3 , high operating voltage is maintainable over a long period of time.

[0011]

[Effect of the Invention] Since SOFC for internal property modification which uses the fuel electrode by this invention eased the carbon deposit compared with SOFC for internal property modification using the conventional fuel electrode, it became possible [performing stable power generation for a long time, as shown in said drawing 3]. Thereby, it turns out that the industrial effect in this field of the fuel electrode of this invention is excellent.

[Translation done.]